IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Applicant: Jacobus M. Lemmens et al.

Title: ***Paroxetine Compositions and Processes for Making the Same***

Appl. No.: 10/678,082

Filing Date: 10/6/2003

Examiner: Chris E. SIMMONS

Art Unit: 1612

Confirmation Number: 4414

SUBSTITUTE BRIEF ON APPEAL

Mail Stop Appeal Brief - Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Under the provisions of 37 C.F.R. § 41.37, this Appeal Brief substitutes Appellants' brief filed on December 6, 2010. Appellants previously paid the credit card payment form in the amount of $540.00 covering the 37 C.F.R. 41.20(b)(2) appeal fee, therefore no Appeal fee is believed to be due. If this fee is deemed to be insufficient, however, authorization is hereby given to charge any deficiency (or credit any balance) to the undersigned deposit account 19-0741.

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I. REAL PARTY IN INTEREST

The real party in interest is NOVEN THERAPEUTICS, LLC, which acquired rights to the present application through an assignment recorded on March 2, 2010, on Reel/Frame 024006/0417.

II. RELATED APPEALS AND INTERFERENCES

None.

III. STATUS OF CLAIMS

Cancelled claims: 1-50.

Pending claims: 51-59.

Rejected claims: 51-59.

Objected to claims: none.

Withdrawn claims: none.

Appealed claims: 51-59.

IV. STATUS OF AMENDMENTS

Appellants last amended the claims in an after-final response that was filed on February 11, 2009. The claims were entered by the PTO in response to Appellants' Request for Continued Examination that was filed on March 11, 2009. *See* non-final Office Action dated June 3, 2009, page 2. The claims have not been further amended since that time.

V. SUMMARY OF CLAIMED SUBJECT MATTER

Appealed, independent claim 51 is directed to a pharmaceutical composition that comprises a sulfonate salt of paroxetine. *See* specification at page 3, line 30 to page 4, line 1. *See also* specification at page 5, lines 6 and 21-22. The composition further comprises calcium hydrogen phosphate anhydrate in the form of plate shaped crystals of agglomerates thereof (*see* specification as amended on Oct. 17, 2007) at page 13, lines 6-7) and it comprises a disintegrant and lubricant. *See* specification, page 4, line 3 and page 6, lines 18-19. However, the composition does not contain lactose or microcrystalline cellulose. *See* specification, page 8, lines 12-14. Finally, the claimed composition has a pH within the range of 5.0 to 6.0. *See* specification, page 7, line 22.

Appealed, independent claim 56 is directed to a pharmaceutical composition that comprises a sulfonate salt of paroxetine (*see* specification at page 3, line 30 to page 4, line 1; *see also* specification at page 5, lines 6 and 21-22), calcium hydrogen phosphate anhydrate in the form of plate shaped crystals of agglomerates thereof (*see* specification as amended on Oct. 17, 2007 at page 13, lines 6-7), a disintegrant and lubricant (*see* specification, page 4, line 3 and page 6, lines 18-19), and that has a pH within the range of 5.0 to 6.0. *See* specification, page 7, line 22. The composition has an added water content of 1.2 wt% or less. *See* specification, page 8, lines 31-31.

Compositions in accordance with the appealed claims exhibit surprising stability against the formation of a colored impurity that heretofore accompanied the formation of paroxetine sulfonate salt compositions. *See* specification at page 3, lines 14-29.

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

The only rejection is against claims 51-59 for being allegedly unpatentable under 35 U.S.C. § 103(a) over U.S. Patent No. 6,113,944 to Pathak *et al.* ("Pathak") in view of U.S. Patents No. 5,874,447 to Benneker *et al.* ("Benneker") and No. 4,675,188 to Chu.

VII. ARGUMENT

The Examiner's sole rejection of claims 51-59 embodies clear legal and factual error. Accordingly, Appellants respectfully urge the Board to reverse the rejection.

The Examiner cited Pathak for alleged disclosure of paroxetine formulations with excipients such as calcium phosphate, sodium starch glycolate and magnesium stearate.[1] The Examiner acknowledge that Pathak does not, however, teach or suggest the use of a sulfonate salt of paroxetine or calcium hydrogen phosphate anhydrate in the form of plate shaped crystals or agglomerates.[2] Moreover, the Examiner acknowledge that Pathak does not teach or suggest that the paroxetine formulations have a pH of 5.0 to 6.0.[3]

Benneker was cited for alleged teaching of sulfonate salts of paroxetine.[4] Further, the Examiner cited Benneker for alleged suggestion that such salts exhibit greater solubility.[5]

Finally, the Examiner cited Chu for teaching the use of calcium hydrogen phosphate anhydrate ("CHP") for direct compression tableting.[6] Critical to the stated rejection, the Examiner relied upon Chu also for its teachings regarding pH, as discussed in more detail below.[7]

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[1] *See* Non-final Office Action dated January 1, 2008, page 2.

[2] *Id.*

[3] *See* Non-final Office Action dated January 1, 2008, page 3.

[4] *Id.*

[5] *Id.*

[6] *Id.*

[7] *See* Non-final Office Action dated January 1, 2008, page 4.

The rejection hinges upon at least two errors. First, the Examiner contended that the "prior art suggest[s] a composition that is substantially identical to that which is claimed . . ." and, hence, the prior art compositions would "reasonably be considered" to possess the claimed pH of 5.0 to 6.0.[8]

Second, the Examiner asserted that because Chu teaches a pH of a reaction medium in which calcium hydrogen phosphate ("CHP") can be prepared, then the final product, CHP, "is reasonably considered to maintain a similar – if not the same – pH when mixed with the active ingredients to form the tablet,"[9] even though no scientific theory supports this extrapolation of pH of a component, CHP, to pH of a composition containing that component. The Examiner asserted in this regard that Chu teaches pH adjustment of the reactions that produce CHP; hence, according to the Examiner, pH can affect "the shape and size of [CHP] particles," by identifying pH as a parameter suitable for optimizing.[10] Based upon this assertion, the Examiner concluded that "the pH [of the claimed composition] is still reasonably considered to be the same."[11]

A. Chu Does Not Suggest pH of a Composition that Contains Calcium Hydrogen Phosphate

The rejection is founded on factual error because the only pH discussed by Chu is that of a reaction medium from which anhydrous dicalcium phosphate is ultimately isolated.[12] Chu does

[8] Final Office Action dated May 11, 2010 at page 3; *see also* Interview Summary dated October 13, 2009.

[9] Final Office Action dated May 11, 2010, page 4 (emphasis added)

[10] Final Office Action dated May 11, 2010, page 3

[11] Final Office Action dated May 11, 2010, page 4

[12] *See* Chu at col. 1, line 64 to col. 2, line 8 and at col. 3, lines 42-48.

not teach the pH of any resulting CHP product nor does the reference hint at pH of a pharmaceutical composition that comprises the CHP product. Chu's disclosure of pH is irrelevant to the claimed invention not because such pH applies in a different context, but because it describes a completely different substance, a reaction medium, not a pharmaceutical composition comprising CHP and other components, as claimed.

Because Chu utterly fails to teach or suggest pH of its anhydrous dicalcium phosphate, the skilled artisan has no reasonable expectation that Chu's CHP product will possess a given pH. Even if it is assumed, *arguendo*, that Chu does somehow suggest a pH of its CHP product, there still remains no reasonable expectation that a composition comprising Chu's CHP product together with an active agent and other excipients would have a pH of 5.0 to 6.0, as prescribed by the rejected claims.

Apparently responsive to these considerations, the Examiner highlighted teaching in Appellant's own specification that pH of a composition can be adjusted by selection of excipients, such as dicalcium phosphate, which can be acidic or neutral, depending on the particular species of dicalcium phosphate and how it is processed during manufacture.[13] Yet, this is a legal red herring that cannot support an obviousness rejection, which must be based on the teachings of the prior art.

What is relevant here is that none of the cited prior art references, such as Chu, gives the skilled artisan a reason to adjust pH of dicalcium phosphate, teaches how to adjust pH, or

[13] Final Office Action dated May 11, 2010, page 4

indicates what pH might pertain to a composition that contains dicalcium phosphate of a given pH. Simply put, no combination of the cited prior art teaches or suggests a composition having pH within the range 5.0 to 6.0, as claimed. Accordingly, there is not even a *prima facie* cases of obviousness.

The rejection devolves essentially to the fact-starved allegations that (i) Chu teaches pH of dicalcium phosphate (which it does not), and (ii) pH is an attribute of a pharmaceutical composition comprising the dicalcium phosphate. Because both allegations get nowhere near the claimed invention without factual and legal errors to bridge the gap, the rejection is improper and should be withdrawn.

B. The Cited Prior Art Does Not Suggest a Composition that Inherently Possesses a pH of 5.0 to 6.0

The rejection also manifests legal error by veiling a doctrine of inherency[14] in a conclusion that prior art "ingredients," when combined, would "reasonably be considered to have similar pH values [as the claimed composition] unless otherwise proven."[15] The Examiner's reasoning, in essence, arrives at precisely the same point from which it departs: since a known composition possesses certain properties, *ipso facto*, then no such property can be unexpected for purposes of a section 103 analysis.

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[14] The Final Office Action does not actually invoke the term "inherency", *per se*, but it does cite to MPEP § 2112.01 [R-3], which explicitly elaborates upon the doctrine of inherency in anticipation and obviousness rejections. Final Office Action dated May 11, 2010, page 4.

[15] Final Office Action dated May 11, 2010, page 3

Yet, by the Examiner's own admission, the claimed composition is not known, *per se*, but rather at best would have been obvious from the combined teachings of Pathak, Benneker, and Chu. The factual and legal errors surrounding this assertion are outlined above. Given the fact that none of the cited references hint at pH of any "ingredient," much less of the composition as a whole (as claimed), there is no factual basis for the assertion that a hypothetical composition that might be made by selecting and combining different components from the cited references, and that would possess a pH within the range of 5.0 to 6.0 as claimed. The pH of CHP is not fixed, but instead varies according to its method of manufacture. Hence, a composition that comprises CHP does not necessarily possess the presently recited pH of 5.0 to 6.0. The Examiner therefore erred by relying upon inherency in this context.

Indeed, the specification sets forth countervailing evidence that rebuts a rejection based on inherency by showing that any putative prior art composition does not "necessarily possess the characteristics of the claimed product."[16] The application presents in some detail that commercially available CHP is "generally alkaline; i.e. pH greater than 7 . . ."[17] For instance, the product Dl-TAB has a pH of about 7.4.[18] Yet, some CHP gives rise to acidic or neutral pH, which depends on the form and grade of CHP and whether and to what extent impurities remain in the CHP after processing.[19] Still, CHP is generally acknowledged to have a pH of about 7.3.[20]

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[16] *In re Best*, 562 F.2d 1252, 1255 (CCPA 1977).

[17] Specification, page 7 (emphasis added)

[18] *Id.*

[19] Specification, pages 7-8

[20] Specification, page 8

The pH of a composition can be governed by a blend of CHP products, each having their different respective pH values, and by excipients other than CHP.[21] Accordingly, the skilled artisan cannot know *a priori* the pH of a given CHP-containing composition. Because Chu does not teach the pH of its anhydrous dicalcium phosphate, there is no basis for the assertion that pH of Chu's CHP and, allegedly, the pH of a composition comprising that CHP, falls within the claimed range of 5.0 to 6.0. To the extent that the skilled artisan might attribute a particular pH to the CHP taught by Chu, it likely would be a basic pH (e.g., greater than 7), as taught in the application for most CHP. Thus, there is absolutely no basis for the Examiner's conclusion that Chu could be understood to directly or inherently suggest the pH of the claimed compositions.

For all of these reasons, the cited combination of Pathak, Benneker, and Chu fails to render obvious the claimed composition. Accordingly, Appellants respectfully urge withdrawal of the rejection.

Respectfully submitted,

Date Dec. 7, 2010

By Steve M. Reid

FOLEY & LARDNER LLP
Customer Number: 22428
Telephone: (202) 295-4767
Facsimile: (202) 672-5399

Steven M. Reid, Ph.D.
Attorney for Applicant
Registration No. 54,393

[21] *Id.*

VIII. CLAIMS APPENDIX

51. A pharmaceutical composition comprising a sulfonate salt of paroxetine, calcium hydrogen phosphate anhydrate in the form of plate shaped crystals or agglomerates thereof, a disintegrant and a lubricant, wherein said composition does not contain lactose or microcrystalline cellulose, and wherein said composition has a pH within the range of 5.0 to 6.0.

52. The composition according to claim 51, wherein said composition does not contain a hydrosoluble or hydrophilic diluent.

53. The composition according to claim 51, wherein said contains said calcium hydrogen phosphate anhydrate as the only diluent.

54. The composition according to claim 51, wherein said sulfonate salt of paroxetine is paroxetine methane sulfonate.

55. The composition according to claim 51, which consists essentially of paroxetine methane sulfonate, calcium hydrogen phosphate anhydrate, sodium starch glycolate, and magnesium stearate.

56. A pharmaceutical composition comprising a sulfonate salt of paroxetine, calcium hydrogen phosphate anhydrate in the form of plate shaped crystals or agglomerates thereof, a disintegrant and a lubricant, wherein said composition has a pH within the range of 5.0 to 6.0 and said composition has an added water content of 1.2 wt% or less.

57. The pharmaceutical composition according to claim 56, which has an added water content of 0 to 1.0 wt%.

58. The composition according to claim 56, which has an added water content of 0 to 0.8 wt%.

59. The composition according to claim 56, wherein said sulfonate salt is paroxetine methane sulfonate.

IX. EVIDENCE APPENDIX

1. U.S. Patent No. 3,095,269 entered into the record on July 8, 2008.

3,095,269

CONVERSION OF CALCIUM HYDROGEN PHOSPHATE DIHYDRATE TO THE ANHYDROUS FORM

Vincent Chiola and Clarence D. Vanderpool, Towanda, Pa., assignors to Sylvania Electric Products Inc., a corporation of Delaware

No Drawing. Filed Oct. 12, 1960, Ser. No. 62,097
2 Claims. (Cl. 23—109)

This invention relates to a novel method for preparing very highly crystalline, closely-sized, luminescent grade, anhydrous dibasic calcium phosphate, $CaHPO_4$, possessing characteristic form and habit.

Since crystallinity and size of luminescent grade $CaHPO_4$ are reflected in the crystallinity and size of the phosphor manufactured therefrom and ultimately in the performance of the end-product fluorescent lamp, it has been found extremely desirable to control the starting phosphate raw material used in the synthesis of calcium halophosphate phosphors.

The purpose and object of this invention is to provide anhydrous dibasic calcium phosphate for use in phosphors and possessing a high degree of crystallinity, a narrow particle size distribution, uniform crystal size, relatively little agglomeration or aggregation, optimum bulk density and characteristic, plate-like crystals.

Previous practice, used in preparing luminescent grade $CaHPO_4$, was to mix solutions of a calcium salt, generally calcium chloride, with diammonium phosphate (DAP) at temperatures greater than 60° C. The anhydrous $CaHPO_4$ thus precipitated was washed, recovered by filtration and dried in the usual manner. An alternative practice was to mix DAP and calcium chloride solution at temperatures ranging from room temperature to 65° C., to precipitate calcium hydrogen phosphate dihydrate ($CaHPO_4 \cdot 2H_2O$). After separation from its mother liquor the dihydrate was converted (dehydrated) to anhydrous material by normal drying methods.

Products prepared by the prior method of mixing hot solutions of DAP and $CaCl_2$ are generally characterized by poor crystallinity, i.e., many fines, poorly formed crystals (spherulitic growths, etc.), wide particle size distribution, relatively high degree of agglomeration and aggregation, varying bulk density and a three dimensional type of crystal of considerable thickness. This is not the type of calcium hydrogen phosphate which is most desirable for synthesis of calcium halophosphate phosphors, useful in fluorescent lamp manufacture.

The alternative practice of drying the highly crystalline dihydrate to anhydrous $CaHPO_4$ produces a material having many of the same disadvantages. Dehydration of the dihydrate using normal mechanical drying practices usually results in highly agglomerated and aggregated anhydrous $CaHPO_4$. There is, in addition, a problem of controlling drying rate to effect gradual release of large quantities of chemically bonded water or water of crystallization. Excessive rate of drying tends to cause degradation of well-formed crystals due to sudden release of the water, resulting in excessive break-up or fracture of dihydrate particles, fines and wide size distribution. Finally, this method has an economic disadvantage because of the necessity for isolating or separating the dihydrate ($CaHPO_4 \cdot 2H_2O$) before conversion (dehydration) to anhydrous $CaHPO_4$.

Control of the calcium hydroxyl apatite (or tricalcium phosphate) content tends to drift away from the optimum as indicated by the nominal mole ratio, Ca/P=1.03, in both the usual and alternative practice. It is extremely desirable to have a raw material of Ca/P mole ratio as close as possible to the theoretical mole ratio of 1.00 for $CaHPO_4$. The presence of higher phosphates makes the

synthesis of calcium halophosphate phosphors much more critical, as is well known in the art.

We have found that calcium hydrogen phosphate dihydrate ($CaHPO_4 \cdot 2H_2O$) can be converted (dehydrated) to anhydrous $CaHPO_4$ by heating (65–104° C.) in aqueous medium, preferably in its own mother liquor. This is unexpected because crystals would usually become hydrous under such conditions. The anhydrous calcium hydrogen phosphate has a high degree of crystallinity, relatively uniformly-sized particles, narrow particle size distribution range, relatively little agglomeration or aggregation, is essentially pure anhydrous calcium hydrogen phosphate and consists of plate-like crystals.

Diammonium phosphate is added to a solution of calcium salt at temperatures below 65° C. to form crystalline calcium hydrogen phosphate dihydrate ($CaHPO_4 \cdot 2H_2O$). While still at the temperature of precipitation, the pH of the dihydrate slurry is adjusted with mineral acid. The slurry is then heated to boiling to effect conversion (dehydration) of the $CaHPO_4 \cdot 2H_2O$ to anhydrous $CaHPO_4$. Conversion is invariably accompanied by a characteristic drop in pH from the value at which the slurry was initially adjusted to a value in the 2.2–3.6 range, depending on the starting pH.

The dihydrate and the resulting anhydrous product are readily identifiable from X-ray data. The conversion (dehydration) can also be readily followed by microscopic examination of the products at each stage.

Product yields range from 50 to 90% of theoretical yield, based on calcium, depending mainly on the pH to which the dihydrate is adjusted (conversion pH) before boiling.

One advantage of the invention is the improvement in the properties of the dibasic calcium phosphate produced, as explained in the foregoing.

A further advantage is the simplicity, ease and convenience of achieving conversion (dehydration) of dihydrate without separation from mother liquor, eliminating costly and time consuming steps which would normally be involved.

Still another advantage is the enhanced performance of fluorescent lamps, manufactured with the product of the invention.

There are numerous modifications and variations in methods which can be used without departing from the spirit of the invention. These, however, are mainly in the category of varying conditions for preparing dihydrate. The basic procedure, i.e., converting dihydrate $CaHPO_4 \cdot 2H_2O$ to anhydrous $CaHPO_4$ by heating (65–104° C.) in aqueous medium, preferably mother liquor, is applicable to all such variations.

The sole, critical condition for achieving such conversion (dehydration) of dihydrate ($CaHPO_4 \cdot 2H_2O$ consistently to produce the advantages of the invention is to heat a pH-adjusted dihydrate slurry.

The mixing of boiling solutions of calcium salt and diammonium phosphate (DAP) or mono-ammonium phosphate (MAP), or adding a boiling DAP (or MAP) aqueous solution to a boiling calcium salt solution has been described in a U.S. patent disclosure, Serial No. 827,173, filed July 15, 1959, by Mooney et al. Such methods do not achieve the results of the present invention, for the calcium phosphate precipitated at temperatures greater than 65° C. has been identified as anhydrous calcium hydrogen orthophosphate. The present invention depends on formation of dihydrate and subsequent dehydration.

Variations such as raw materials, temperature of dihydrate precipitation, conversion pH, mineral acid used to adjust pH and heating period may have an effect on crystal habit, crystal size, size distribution, degree of crystallinity, aggregation and/or agglomeration, yield,

ease of recovery by filtration, etc., of the final product but do not in any way affect the implementation of the invention to the dihydrate slurry.

Dihydrate ($CaHPO_4 \cdot 2H_2O$) for use as a starting material in our process may be prepared from a calcium salt solution and diammonium phosphate (DAP) as the source of phosphate ion. The source of phosphate ion may also be mono-ammonium phosphate (MAP) or a mixture of a suitable grade phosphoric acid and ammonium hydroxide. DAP and MAP may be added to calcium salt solution as solids or in solution.

The source of calcium may be any of the common salts which are commercially available, depending on economic considerations. Calcium chloride, calcium nitrate, calcium formate, calcium acetate, calcium carbonate (in phosphoric acid) and even limestone (in phosphoric acid) are all satisfactory sources of calcium.

Dibasic calcium phosphate dihydrate, ($CaHPO_4 \cdot 2H_2O$) may be precipitated within the practical range of about 20° C. to 65° C.

Within this range, the temperature is not critical. A preferred and convenient temperature for dihydrate preparation is room temperature 20–30° C.

Prior to conversion (dehydration) by heating, the pH of the dihydrate slurry may be adjusted to any value ranging from 2.5 to 5.5. For practical reasons, i.e., yield, we have established a lower limit of 3.0 but all of the advantages of the invention may be realized when operating within this range. The pH to which dihydrate slurry is adjusted before conversion affects crystal habit, crystal size and yield. Operating at the lower end of the range tends to give diamond-shaped crystals, larger size crystals but lower yield. Operating at the upper end of the range tends to give cubic crystals of smaller size, and increased yield.

The pH of dihydrate slurry may be adjusted before conversion (dehydration) with either hydrochloric acid, nitric acid, phosphoric acid, or mixtures of any two or three of these acids. We prefer to use nitric acid in systems where calcium nitrate is the starting material, hydrochloric acid where calcium chloride is the starting material.

The concentration of calcium in solution may range from 0.1 molar to 3 molar; similarly, the concentration of DAP may be varied over the same range. We prefer to work at concentrations in the range of 0.5 molar.

The dihydrate slurry may be formed from solutions containing a 1:1 mole ratio of calcium to phosphate (stoichiometric). The starting calcium to phosphate ratio in solution may range from 3:1 to 1:3.

After suitably adjusting pH and achieving boiling conditions, boiling may range from a few minutes to four hours. The length of the boiling period depends mainly on concentration and the size of the starting dihydrate crystals.

Embodiments of the invention are illustrated in the following specific examples:

Example 1

43.2 pounds of calcium was dissolved in 140 gallons of deionized water and total volume was adjusted to 160 gallons. 34.8 pounds of DAP solids (commercial diammonium phosphate) was added to the calcium nitrate solution to form calcium hydrogen phosphate dihydrate at room temperatures (25° C.). A volume of 4650 ml. of concentrated hydrochloric acid was added to adjust the pH of the slurry to 3.6. The slurry was heated to boiling; temperature was recorded at 101–103° C. After 5 minutes there occurred a characteristic drop in pH to 2.5–2.6, indicating conversion (dehydration). Conversion was confirmed by microscopic examination. A yield of 16 pounds of dry product was obtained, equivalent to 64.5% of theoretical (24.9 pounds) based on calcium. The product consisted of diamond-shaped, plate-like crystals which were relatively non-agglomerated.

Example 2

314.8 pounds of calcium nitrate was dissolved in 140 gallons of deionized water and total volume was adjusted to 160 gallons. 175.7 pounds of DAP solids was added to the calcium nitrate solution to form dihydrate at room temperature. The dihydrate slurry was adjusted to a pH of 2.9 with 10,000 ml. of reagent HNO_3. The slurry was heated to boiling and after one-half hour there occurred a characteristic pH drop to about 2.1, indicating conversion or dehydration. This was confirmed by microscopic examination of the product. A yield of 128 pounds, 70.3% of theoretical (183 pounds) based on calcium was obtained. The product consisted of diamond-shaped, plate-like crystals.

Example 3

48 pounds of purified calcium chloride was dissolved in 140 gallons of deionized water and total volume was adjusted to 160 gallons. 57.3 pounds of DAP solids were added to the calcium chloride solution to form dihydrate at room temperature. The dihydrate slurry was adjusted to a pH of 3.6 with 3,000 ml. of reagent hydrochloric acid. The slurry was heated to boiling and maintained at boiling until there occurred the characteristic pH drop to 2.9, indicating conversion. Total time at boiling was about one hour. Conversion was confirmed by microscopic examination. The product consisted of highly-crystalline, diamond-shaped, plate-like crystals. Yield was 44 pounds equivalent to 74.5% of theoretical (59 pounds) based on calcium.

Example 4

148 pounds of purified $CaCl_2$ was dissolved in 140 gallons of deionized water and total volume was adjusted to 160 gallons. 175.7 pounds of DAP solids were added to the chloride solution at room temperature (25° C.) to form dihydrate. The dihydrate slurry was adjusted at room temperature to a pH of 3.8 with 4,000 ml. of hydrochloric acid. The slurry was heated to a boiling and maintained at boiling until there occurred a characteristic drop in pH of 2.5–2.6, indicating conversion. Total time at boiling was about one hour. Conversion was confirmed by microscopic examination of the product. The product consisted of highly-crystalline, diamond-shaped, plate-like crystals and crystal size tended to be small. Yield was 159 pounds, 87.7% of theoretical (181 pounds) based on calcium.

Example 5

62.8 pounds of calcium nitrate was dissolved in 140 gallons of deionized water and total volume was adjusted to 160 gallons. 69.6 pounds of DAP solids was added to the nitrate solution at room temperature to form dihydrate. The dihydrate slurry was adjusted to a pH of 4.4 with 1100 ml. of nitric acid. The slurry was heated to boiling until there occurred a characteristic drop in pH to 3.5. Total time at boiling was about one hour. Conversion was confirmed by microscopic examination. The product was highly crystalline; crystals were plate-like but had a cubic and sod-like crystal habit. This illustrates change in habit with high conversion pH values. Yield was 32 pounds or 88.6% of theoretical, illustrating a trend to higher yield with higher conversion pH values.

The range of temperatures given for heating in the foregoing examples do not exceed 104° C. However, if the ambient pressure, which will generally be atmospheric, is high, the boiling point of the heated material may be somewhat above 104° C., and the mixture can be heated to the higher boiling point. However, higher pressures than standard atmospheric will not ordinarily be desirable.

What we claim is:

1. A process of converting calcium hydrogen phosphate dihydrate to anhydrous calcium hydrogen phos-

phate, which process comprises adjusting the pH of the dihydrate in its own mother liquor to a value between about 2.5 to 5.5, by adding acid, then heating the dihydrate in its own mother liquor to a temperature between about 65° C. and its boiling point until the pH drops substantially below its initial value to a value between about 2.2 to 3.6, and recovering the resultant anhydrous phosphate from the remaining mother liquor.

2. A process of converting calcium hydrogen phosphate dihydrate to anhydrous calcium hydrogen phosphate, which process comprises adjusting the pH of the dihydrate in an aqueous medium to a value between about 2.5 to 5.5 by adding acid, then heating the dihydrate in the aqueous medium to a temperature between about 65° C. and its boiling point until the pH drops substantially below its initial value to a value between about 2.2 to 3.6, and recovering the resultant anhydrous phosphate from the aqueous medium.

References Cited in the file of this patent

Van Wazer: Phosphorus and its Compounds, vol. 1, Chemistry, Interscience Publishers, N.Y., 1958, pages 519–522.

X. RELATED PROCEEDINGS APPENDIX

None.